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Public Groundwater Supplies in Bond County

by DOROTHY M. WOLLER

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Introduction

This publication presents all available information on production wells used for public groundwater supplies in Bond County. Bulletin 60, which is divided by county into separate publications, supersedes Bulletin 40 and its Supplements 1 and 2.

The definition of public water supply as contained in the Environmental Protection Act of 1970 was used to determine those water systems and wells to be included. Systems and wells described furnish water for drinking or general domestic use in: 1) incorporated municipalities; 2) unincorporated communities where 10 or more separate lots or properties are being served or are intended to be served; 3) state-owned parks and memorials; and 4) state-owned educational, charitable, or penal institutions.

This report includes descriptions for groundwater supplies of 3 municipalities in Bond County. These are preceded by brief summaries of the groundwater geology of the county and the development of groundwater sources for municipal use. An explanation of the format used in the descriptions is also given.

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Geology

The geology of Bond County is described generally in Illinois State Geological Survey Circular 225, *Groundwater Geology in South-Central Illinois*. The following brief discussion of geologic conditions in the county is taken largely from that publication. For a more detailed definition of the geology in this portion of the state, the reader is referred to the State Geological Survey which is located on the University of Illinois campus, Urbana.

Thin sand and gravel deposits suitable for the construction of drilled wells for farm and domestic supplies are scattered throughout a large part of Bond County. The valleys of the East Branch of Shoal Creek and Beaver Creek contain sand and gravel deposits that are suitable locally for large groundwater supplies. However, considerable testing usually is required to determine the thicker and more permeable parts of these aquifers.

In the western and northeastern parts of the county the glacial drift is thin and the bedrock in many places is at the surface. Here wells are finished in the upper Pennsylvanian bedrock.

In the middle of the county, a preglacial valley contains unconsolidated material 100 to 175 ft thick. Although the character of the unconsolidated material in the valley is not known, sand and gravel deposits suitable for the construction of wells for domestic, farm, and larger supplies may be present. Further exploration is warranted in this area.

Water for farm and domestic supplies is obtained from shallow Pennsylvanian sandstones at depths ranging from 100 to 300 ft in the northeast part of the county and at depths ranging from 60 to 130 ft below land surface in the area of Beaver Creek in the southern part of the county.

Groundwater Development for Municipal Use

Unconsolidated sand and gravel deposits associated with the valleys of the East Branch of Shoal Creek and Beaver Creek are tapped as the sources for the three municipal supplies in Bond County. At Greenville, Mulberry Grove, and Pocahontas, there are presently nine municipal wells tapping these aquifers to depths ranging from 31 to 74 ft. Their reported yields range from 12 to 250 gpm depending primarily upon the type of well and the permeability, thickness,

and areal extent of the sand and gravel unit tapped by each well. Production from these wells was estimated to be 335,000 gpd in 1972. Analyses of water they produce indicate that the iron content ranges widely (from 0.0 to 36 mg/l) and the hardness from 80 to 508 mg/l. Groundwater for all the municipal supplies is chlorinated and fluoridated. In addition, water for Mulberry Grove and Pocahontas is aerated, settled, and filtered for iron removal, and at Pocahontas the pH is adjusted.

Format

In this publication the descriptions of public groundwater supplies are presented in alphabetical order by place name as follows: Greenville, Mulberry Grove, and Pocahontas.

At the beginning of each description the U.S. Census of population for 1970 is given for incorporated places.

The number of services and quantity of water distributed at each supply are given where available for the earliest and the latest reported values.

Individual production wells for each supply are described in the order of their construction. The description for each well includes the *aquifer tapped*,

date drilled, depth, driller, legal location, elevation in feet above mean sea level, log, construction features, yield, pumping equipment, and chemical analyses.

The screen sizes given in this publication are for continuous slot type screens unless stated otherwise. Slot sizes given indicate the width of the slot openings in thousandths of an inch. For example, a 20 slot screen has slot openings 0.020 in. wide and a 100 slot screen has slots 0.100 in. wide. Approximate equivalent slot openings for other types of screens are given in parentheses after the screen designation.

Abbreviations Used

ft.....	foot (feet)
gpd.....	gallons per day
gpm.....	gallons per minute
hp.....	horsepower
hr.....	hour(s)
ID.....	inside diameter
in.....	inch(es)
Lab.....	laboratory
me/l.....	milliequivalents per liter
mg/l.....	milligrams per liter
min.....	minute(s)
No.(s).....	number(s)
OD.....	outside diameter
R.....	range
rpm.....	revolutions per minute
T.....	township
TDH.....	total dynamic head

GREENVILLE

The city of Greenville (4631) installed a public water supply in 1884. Groundwater was used exclusively as a source of supply from 1884 until 1970. A surface water reservoir completed in 1970 now furnishes part of the total water demand for the city. In 1951 there were 1400 services, all metered; the average daily pumpage was 275,000 gpd. In 1972 there were 1800 services, all metered; the estimated average and maximum daily pumpages were 482,933 and 540,200 gpd, respectively. The groundwater is chlorinated and fluoridated.

Prior to the installation of the surface water supply in 1970, water demands of the city increased from less than 100,000 gpd to more than 450,000 gpd. After about 1952, total yearly withdrawals from the city wells generally exceeded the long-term safe yield of the shallow sand and gravel formations tapped as their source of supply. In an attempt to meet ever-increasing water demands, more than 50 test wells were drilled within a 3-mile radius of town and a total of 23 production wells were constructed, some at locations as far as 2 miles from town. Since July 1, 1970, the municipal water supply for the city has been obtained from a surface water reservoir located about 2 miles north of town and from two production wells (Nos. 2 and 5) located in the south part of the city.

A discussion of groundwater development and wells constructed before 1932 is included in Bulletin 40; a brief description of wells constructed since that time follows.

WELL NO. 1 (East Well), finished in sand and gravel, was completed in 1932 to a depth of 68 ft by John Hampton, Greenville. Use of this well was discontinued prior to 1962 and it is now abandoned and sealed. The well is located on the east side of Bond St., 3 blocks W and 1 block S of the main pumping station, approximately 1000 ft S and 2500 ft W of the NE corner of Section 15, T5N, R3W. The land surface elevation at the well is approximately 575 ft.

A drillers log of Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Clay	42	42
Coarse sand and gravel	26	68

A 36-in. diameter hole was drilled to a depth of 68 ft. The well is cased with 36-in. steel pipe to a depth of 51 ft followed by 17 ft of 18-in. brass screen. The annulus surrounding the strainer was packed with a 9-in. thick gravel envelope.

Upon completion, the well reportedly produced 250 gpm for 1 hr with a drawdown of 1 ft from a nonpumping water level of 42 ft below the top of the well.

Well NO. 2 (West Well), finished in sand and gravel, was completed in 1932 to a depth of 65 ft by John Hampton, Greenville. The well is located 60 ft W of Well No. 1, approximately 1000 ft S and 2560 ft W of the NE

corner of Section 15, T5N, R3W. The land surface elevation at the well is approximately 575 ft.

A sample study log of Well No. 2 furnished by the State Geological Survey follows:

Formation	Thickness (ft)	Depth (ft)
PLEISTOCENE SYSTEM		
Silt, sandy, and clayey	8	8
Sand and granule gravel	27	35
Granule gravel, clean	20	55
Gravel, clean	10	65

A 36-in. diameter hole was drilled to a depth of 65 ft. The well is cased with 36-in. steel pipe to a depth of 55 ft followed by 10 ft of 24-in. brass screen. The annulus surrounding the strainer was packed with a 6-in. thick gravel envelope.

Upon completion, the well reportedly produced 250 gpm for 1 hr with a drawdown of 1 ft from a nonpumping water level of 42 ft below the top of the well.

In November 1948, this well was rehabilitated and the screen and casing replaced.

The pumping equipment presently installed is a Peerless turbine pump rated at 200 gpm and powered by a 7½-hp 1760 rpm General Electric motor (Serial No. YP51114026).

The following mineral analysis (Lab. No. 187348) is for a water sample from the well collected December 16, 1971, after 30 min of pumping at 150 gpm.

WELL NO. 2, LABORATORY NO. 187348

		mg/l	me/l			mg/l	me/l
Iron (total)	Fe	0.0		Silica	SiO ₂	19.4	
Manganese	Mn	0.00		Fluoride	F	0.2	
Ammonium	NH ₄	0.2	0.01	Boron	B	0.2	
Sodium	Na	60.8	2.64	Nitrate	NO3	36.0	0.58
Potassium	K	1.7	0.04	Chloride	Cl	44	1.24
Calcium	Ca	124.0	6.19	Sulfate	SO ₄	168.3	3.50
Magnesium	Mg	44.9	3.69	Alkalinity (as	CaCO ₃)	368	7.36
Strontium	Sr	0.10					
				Hardness (as	CaCO ₃)	494	9.88
Barium	Ba	<0.1					
Copper	Cu	0.00		Total dissolved minerals		708	
Cadmium	Cd	0.00					
Chromium	Cr	0.00					
Lead	Pb	<0.05					
Lithium	Li	0.01		Turbidity	0		
Nickel	Ni	<0.05		Color	0		
Zinc	Zn	0.02		Odor	0		

WELL NO. 3 (North Well), finished in sand and gravel, was completed in 1939 to a depth of 69 ft by John Hampton, Greenville. Use of this well was discontinued prior to 1954 and it is now abandoned and sealed. The well is located 50 ft N of Well No. 1, approximately 1190 ft S and 2500 ft W of the NE corner of Section 15, T5N, R3W. The land surface elevation at the well is approximately 575 ft.

A 36-in. diameter hole was drilled to a depth of 69 ft. The well is cased with 21-in. steel pipe from 1.5 ft above the pump house floor to an unknown depth followed by a 21-in. diameter screen. The annulus surrounding the

screen was packed with gravel.

Upon completion, the nonpumping water level was reported to be 51 ft below land surface.

A mineral analysis of a sample (Lab. No. 116363) collected November 4, 1948, showed the water to have a hardness of 547 mg/l, total dissolved minerals of 776 mg/l, and an iron content of 0.1 mg/l.

WELL NO. 4, finished in sand and gravel, was completed in 1954 to a depth of 60 ft by Steve Neer, Greenville. In 1962, this well was reported as being abandoned and sealed. The well is located 50 ft NW of Well No. 2, approximately 965 ft S and 2595 ft W of the NE corner of Section 15, T5N, R3W. The land surface elevation at the well is approximately 575 ft.

A 36-in. diameter hole was drilled to a depth of 60 ft. The well is cased with 36-in. outer pipe to an unknown depth. Inside casing and well screen data are not available.

WELL NO. 5, finished in sand and gravel, was completed in 1959 to a depth of 74 ft by the Layne-Western Co., Kirkwood, Mo. The well is located 80 ft S of Franklin Ave. between Fifth and Sixth Sts., approximately 1250 ft S and 1700 W of the NE corner of Section 15, T5N, R3W. The land surface elevation at the well is approximately 570 ft.

A drillers log of Well No. 5 follows:

Formation	Thickness (ft)	Depth (ft)
Topsoil	1	1
Tanclav	7	8
Light blue sandy clay	2	10
Light brown sandy clay	4.5	14.5
Brown sandy clay with gravel	10.5	25
Fine and medium sand	5	30
Fine and medium sand, some clay	4	34
Medium and medium fine sand	6	40
Medium and coarse sand	5	45
Medium and coarse sand with clay	5	50
Medium and coarse sand, some gravel	5	55
Coarse and medium sand and gravel	16.5	71.5
Blue clay hard	2.5	74

The following mineral analysis (Lab. No. 187349) is for a water sample from the well collected December 16, 1971, after 30 min of pumping at 150 gpm.

WELL NO. 5, LABORATORY NO. 187349

		mg/l	me/l			mg/l	me/l
Iron (total)	Fe	0.0		Silica	SiO ₂	196	
Manganese	Mn	0.00		Fluoride	F	0.2	
Ammonium	NH ₄	0.1	0.01	Boron	B	0.3	
Sodium	Na	67.7	2.94	Nitrate	NO ₃	26.8	0.43
Potassium	K	1.7	0.04	Chloride	Cl	43	1.21
Calcium	Ca	124.8	6.23	Sulfate	SO ₄	181.8	3.78
Magnesium	Mg	47.8	3.93	Alkalinity (as CaCO ₃)		394	7.88
Strontium	Sr	0.14		Hardness (as CaCO ₃)		508	10.16
Barium	Ba	<0.1		Total dissolved minerals		748	
Copper	Cu	0.00					
Cadmium	Cd	0.00					
Chromium	Cr	0.00					
Lead	Pb	<0.05					
Lithium	Li	0.01		Turbidity		0	
Nickel	Ni	<0.05		Color		0	
Zinc	Zn	0.02		Odor		0	

The well is cased with 30-in. outer pipe from 1 ft above land surface to an unknown depth and 18-in. inner pipe from 1 ft above land surface to a depth of 63.2 ft followed by 10.8 ft of 18-in. brass screen. The

annulus between the casings is filled with concrete grout from 0 to 10 ft and with gravel from 10 to 74 ft.

The pumping equipment presently installed is a Peerless water-lubricated vertical turbine pump set at 64.7 ft below the well top, rated at 200 gpm, and powered by a 7½-hp 1760 rpm General Electric motor.

WELL NO. 6, finished in sand and gravel, was completed in July 1959 to a depth of 121 ft by the Layne-Western Co., Kirkwood, Mo. This well was discontinued in 1970 and the pump removed. The well is located 2 miles south of town, 100 ft S of Route 70, approximately 600 ft N and 1550 ft W of the SE corner of Section 22, T5N, R3W. The land surface elevation at the well is approximately 530 ft.

A drillers log of Well No. 6 follows:

Formation	Thickness (ft)	Depth (ft)
Topsoil and clay	10	10
Yellow clay and gravel	5	15
Gravel, tight	5	20
Hard blue clay, boulders	15	35
Fine sand, very tight	11	46
Sand and gravel, boulders	19	65
Gravel and clay (coal)	5	70
Sand and clay	10	80
Fine sand	6	86
Coarse sand, gravel and some boulders and coal	9	95
Medium sand and gravel	23	118
Sand	3	121
Blue clay	3	124

A 42-in. diameter hole was drilled to a depth of 45 ft and finished 36 in. in diameter from 45 to 121 ft. The well is cased with 36-in. outer pipe from 1 ft above land surface to a depth of 45 ft and 12-in. inner pipe from 3 ft above land surface to a depth of 81 ft followed by 40 ft of 12-in. No. 5 (0.105 in.) Layne shutter screen. The annulus between the 42-in. hole and 36-in. casing was filled with concrete from 0 to 45 ft. The annulus between the 36-in. casing and hole and 12-in. casing and screen was filled with 38 tons of buckshot gravel from 45 to 121 ft.

A production test using three observation wells was conducted July 31-August 1, 1959, by representatives of the driller, the State Water Survey, and Baxter and Woodman, Consulting Engineers. After 16 hr of pumping at 366 gpm, the drawdown was 13.04 ft from a nonpumping water level of 38.71 ft below land surface. On the basis of the production test data, it was estimated that if pumped continuously at 175 gpm (250,000 gpd), the pumping water level would stabilize within 2 years at a stage near the top of the screen in the well.

A production test using two observation wells was conducted by the water superintendent on September 13-16, 1960. After 67 hr of pumping at rates of 280 to 300 gpm, the final drawdown was 21.5 ft from a nonpumping water level of 40.5 ft below land surface.

A partial analysis of a sample (Lab. No. 150647) collected September 21, 1959, showed the water to have a hardness of 328 mg/l, total dissolved minerals of 507 mg/l, and an iron content of 2.6 mg/l.

In 1964, several test holes were drilled in the bottoms of the East Branch Shoal Creek by the Layne-Western Co. These test holes averaged 28 ft in depth and penetrated approximately 10 ft of dirty sand and gravel at the bottom. Well production test data gathered from these test holes indicated that a 2-well system tapping this narrow sand and gravel aquifer would have a long-term yield capability between about 15,000 and 30,000 gpd. No further attempts were made by the city to develop this water-bearing formation after this fact was determined.

WELL NO. 7, finished in sand and gravel, was completed in March 1964 to a depth of 61 ft by the Layne-Western Co., Kirkwood, Mo. This well went dry in January 1970 and was discontinued. The well is located about 0.8 mile N of Route 70 and 60 ft E of the Penn Central RR tracks, approximately 1600 ft N and 1500 ft E of the SW corner of Section 15, T5N, R3W. The land surface elevation at the well is approximately 560 ft.

A drillers log of Well No. 7 follows:

Formation	Thickness (ft)	Depth (ft)
Black top soil	2	2
Light gray clay	9	11
Brown and gray silty clay	3	14
Soft brown fine silty sand	4	18
Loose fine brown sand	1	19
Brown clay	7	26
Fine to coarse rust brown sand	6	32
Loose fine to medium brown sand	6	38
Coarse loose sand and gravel	6	44
Clean loose coarse sand and gravel	10	54
Hard dark gray clay	6	60
(thin layer of clay at 56 ft and some fine sand from 56 to 60 ft)		

A 24-in. diameter hole was drilled to a depth of 61 ft. The well is cased with 12-in. pipe from 1 ft above land surface to a depth of 51 ft followed by 10 ft of 12-in. No. 5 (0.105 in.) Layne stainless steel shutter screen. The annulus between the hole and casing-screen assembly is filled with clay, sand, and bentonite from 0 to 30 ft, and with gravel from 30 to 61 ft.

A production test using two observation wells was conducted by the driller on March 26-27, 1964. After 30 hr of pumping at a rate of 151 gpm, the drawdown was 12.4 ft from a nonpumping water level of 31.0 ft.

Six hr after pumping was stopped, the water had recovered to 31.8 ft.

WELL NO. 8, finished in sand and gravel, was completed in May 1968 to a depth of 95 ft by the Layne-Western Co., Kirkwood, Mo. This well was abandoned in 1970 and its discharge piping was used as a finished water main. The well is located on Ill. Route 127, south of U.S. Route 40, approximately 1500 ft N and 15 ft W of the SE corner of Section 14, T5N, R3W. The land surface elevation at the well is approximately 520 ft.

A drillers log of Well No. 8 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil	2	2
Brown clay	9	11
Coarse sand	2	13
Gray clay, gravel mixed	21	34
Sand	2	36
Gray clay, gravel mixed	9	45
Medium sand, loose	8	53
Gray clay, gravel mixed	10	63
Medium dark sand	34	97
Gray clay	7	104

An 18-in. diameter hole was drilled to a depth of 95 ft. The well is cased with 8-in. steel pipe from 2 ft above land surface to a depth of 80 ft followed by 15 ft of 8-in. No. 5 (0.105 in.) Layne stainless steel shutter screen. The annulus between the hole and casing-screen assembly is filled with concrete from 0 to 3 ft; with clay, sand, and bentonite from 3 to 15 ft; and with gravel from 15 to 95 ft.

A production test was conducted on May 29, 1968, by representatives of the driller, the State Water Survey, and the City Engineer. After 4 hr of pumping at a rate of 122 gpm, the drawdown was 4.20 ft from a non-pumping water level of 51.15 ft below land surface. Twenty min after pumping was stopped, the water level had recovered to 51.55 ft. On the basis of the production test data, it was estimated that this well would yield 120 gpm (172,800 gpd) on a long-term basis.

A partial analysis of a sample (Lab. No. 174927) collected during the initial production test, after pumping for 4 hr at 122 gpm, showed the water to have a hardness of 308 mg/l, total dissolved minerals of 502 mg/l, and an iron content of 2.6 mg/l.

MULBERRY GROVE

The village of Mulberry Grove (697) installed a public water supply in 1943. Although the village is in Bond County, all of the wells are in Fayette County. Three wells (Nos. 1, 3, and 4) are in use. In 1951 there were 155 services, 60 percent metered; the estimated average daily pumpage was 24,000 gpd. In 1972 there were 276 services, of which 178 were metered; the estimated average and maximum daily pumpages were 50,000 and 60,000 gpd, respectively. The water is

aerated, settled, filtered, chlorinated, and fluoridated. On the basis of pumping tests conducted in 1963, it is estimated that approximately 45,000 gpd (about 31 gpm) can be withdrawn from the aquifer on a continuous basis in the vicinity of the present well field without overdeveloping the water-bearing formation.

WELL NO. 1, finished in sand and gravel, was completed in February 1941 to a depth of 40 ft by the Sewell Well Co., St. Louis, Mo. The well is located

about 1 mile southeast of town on the west side of Hurricane Creek, approximately 900 ft S and 1900 ft E of the NW corner of Section 6, T5N, R1W, Fayette County. The land surface elevation at the well is approximately 475 ft.

A correlated drillers log of Well No. 1 furnished by the State Geological Survey follows:

Formation	Thickness (ft)	Depth (ft)
PLEISTOCENE SYSTEM		
Sand, clay, mud	16	16
Sand, muddy	2	18
Clay	10	28
Sand and gravel	12	40

The well is cased with 12-in. outer pipe from 1.8 ft above land surface to a depth of 28 ft and an 8-in. inner pipe from 11 ft above land surface to a depth of 30 ft followed by 10 ft of 8-in. No. 125 slot Cook screen. Gravel was poured in the annular space outside the screen.

Upon completion, the nonpumping water level was reported to be 11.7 ft.

A production test was conducted by the State Water Survey on April 7, 1941. After 6 hr of pumping at a rate of 40 gpm, the drawdown was 19.5 ft from a nonpumping water level of 10.2 ft. One hr after pumping was stopped, the water level had recovered to 15.0 ft.

On January 4, 1946, when pumping at 16 to 17 gpm, the drawdown was estimated to be 6.5 ft. The loss in production was attributed to loss in pump efficiency.

In April 1954 this well was acidized with a reported increase in yield. During the 3 days while the well was out of service, water was pumped directly from a nearby creek to the iron removal treatment plant, using the jet pump from Well No. 2.

E. C. Baker and Sons, Sigel, acidized this well in March 1971, and reported a noticeable reduction in the amount of drawdown at normal pumping rates.

The pumping equipment presently installed is a Webtrol submersible pump (Model No. 15S11LM) set at 37 ft, rated at 15 gpm, and powered by a 1-hp Franklin electric motor.

A mineral analysis of a sample (Lab. No. 116362) collected November 4, 1948, showed the water to have a hardness of 356 mg/l, total dissolved minerals of 486 mg/l, and an iron content of 21.5 mg/l.

WELL NO. 2, finished in sand and gravel, was completed in November 1951 to a depth of 38 ft by the Smith Drilling Co., Farina. This well was abandoned and the pump removed in 1954. The well is located 11 ft W of the Well No. 1 pumphouse, approximately 900 ft S and 1889 ft E of the NW corner of Section 6, T5N, R1W, Fayette County. The land surface elevation at the well is approximately 475 ft.

The well is cased with 8-in. pipe from 1 ft above land surface to a depth of 38 ft. A 3-in. suction pipe was installed from 5 ft below land surface and extended into the Well No. 1 pumphouse where it was screwed into the pump base of Well No. 1.

Six test holes were drilled in 1954 and 1955, at locations from 100 to 275 ft in various directions from Well No. 1. On the basis of the results of these test holes Well No. 3 was constructed.

WELL NO. 3 (Village Well No. 2), finished in sand and gravel, was completed in March 1955 to a depth of 37 ft by Willeford Bros., Highland. The well is located at the site of the most favorable of the six test holes, about 150 ft SW of Well No. 1, approximately 1000 ft S and 1800 ft E of the NW corner of Section 6, T5N, R1W, Fayette County. The land surface elevation at the well is approximately 475 ft.

A drillers log of Well No. 3 follows:

Formation	Thickness (ft)	Depth (ft)
Sandy till	16	16
Wood, sand, some gravel	2	18
Blue to brown clay	11	29
Sand and gravel	6	35
Dark shale with lime shale	2	37

The well is cased with 12-in. outer pipe from 2 ft above land surface to a depth of 30 ft and an 8-in. inner pipe from 12 ft above land surface to a depth of 29.2 ft followed by 8.5 ft of 8-in. ID No. 100 slot Cook screen. The annulus outside the screen was packed with gravel.

A production test was conducted on March 24, 1955, by representatives of the driller, the village, the State Water Survey, and Friedewald Engineering Co., Consulting Engineers. After 5 hr of pumping at rates from 14.2 to 18.0 gpm, the drawdown was 11.0 ft from a nonpumping water level of 17.0 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 18.6 ft.

In March 1971, E. C. Baker and Sons, Sigel, acidized this well and reported a noticeable reduction in the amount of drawdown at normal pumping rates.

The pumping equipment presently installed is a Webtrol submersible pump (Model No. 15S11LM) set at 34 ft, rated at 15 gpm, and powered by a 1-hp 3450 rpm Franklin electric motor.

A mineral analysis of a sample (Lab. No. 145462) collected January 9, 1958, showed the water to have a hardness of 342 mg/l, total dissolved minerals of 501 mg/l, and an iron content of 29 mg/l.

Two test holes, 32 and 37 ft in depth, were drilled in 1960, at locations from 35 to 45 ft from Well No. 1.

WELL NO. 4 (Village Well No. 3), finished in sand and gravel, was completed in December 1962 to a depth of 33 ft by E. C. Baker and Sons, Sigel. The well is located 670 ft NE of Well No. 1, approximately 350 ft S and 2050 ft E of the NW corner of Section 6, T5N, R1W, Fayette County. The land surface elevation at the well is approximately 475 ft.

A drillers log of Well No. 4 follows:

Formation	Thickness (ft)	Depth (ft)
Soil	2	2
Sandy yellow clay	21	23
Sand and gravel, blue	6	29
Sand, green	4	33

A 7-in. diameter hole was drilled to a depth of 33 ft. The well is equipped with a pitless adapter from 12 ft above land surface to a depth of 3 ft and cased with 7-in. OD pipe to a depth of 25 ft followed by an 8-ft length of 6-in. No. 40 slot Cook Red Brass screen.

A production test using two observation wells was conducted on December 31, 1962, by representatives of the driller, the State Water Survey, and Marbry and Johnson, Consulting Engineers. After 6 hr of pumping at a rate of 14.6 gpm, the drawdown was 7.26 ft from a nonpumping water level of 9.72 ft below land surface. One hr after pumping was stopped, the water level had recovered to 10.85 ft. On the basis of the production test data, it was estimated that this well would yield 15 gpm (about 20,000 gpd) on a long-term basis.

In March 1971, E. C. Baker and Sons, Sigel, acidized this well and reported a noticeable reduction in the amount of drawdown at normal pumping rates.

The pumping equipment presently installed is a Webtrol submersible pump (Model No. 15S11LM) set at 30 ft, rated at 15 gpm at about 200 ft TDH, and powered by a 1-hp Franklin electric motor.

The following mineral analysis (Lab. No. 186661) is for a water sample from the well collected Septem-

ber 15, 1971, after 12 hr of pumping at 10 gpm.

WELL NO. 4, LABORATORY NO. 186661									
		mg/l	me/l			mg/l	me/l		
Iron	Fe	10		Silica	SiO ₂	17.1			
Manganese	Mn	0.91		Boron	B	0.1			
Ammonium	NH ₄	0.3	0.01	Fluoride	F	0.1			
Sodium	Na	17.5	0.76	Nitrate	NO ₃	0.5	0.01		
Potassium	K	0.8	0.02	Chloride	Cl	13	0.37		
Calcium	Ca	60.0	2.99	Sulfate	SO ₄	131.9	2.74		
Magnesium	Mg	24.9	2.05	Alkalinity (as CaCO ₃)		136	2.72		
Strontium	Sr	0.12							
				Hardness (as CaCO ₃)		252	5.04		
Copper	Cu	0.02							
Cadmium	Cd	0.00		Total dissolved					
Chromium	Cr	0.00		minerals		352			
Lead	Pb	<0.05							
Lithium	Li	0.02							
Nickel	Ni	<0.05		Turbidity		64			
Zinc	Zn	0.02		Color		0			
Barium	Ba	<0.1		Odor		0			

Between 1968 and 1971, approximately 75 test holes ranging in depth from 14 to 82 ft were drilled in the vicinity of Mulberry Grove. No significant deposits suitable for developing additional wells have been found at any of the tested locations.

POCAHONTAS

The village of Pocahontas (764) installed a public water supply in 1955. Four wells (Nos. 1, 2, 4, and 5) are in use. In 1955 there were approximately 140 services. In 1972 there were 355 services, all metered; the average and maximum daily pumpages were 43,000 and 46,000 gpd, respectively. The water is aerated, settled, pH adjusted, chlorinated, fluoridated, and filtered.

In 1951 surveys were made to determine the capacity of the American Legion Lake for adequacy as a water supply source. After concluding that the lake would be wholly inadequate, a series of test holes were drilled in the vicinity of Pocahontas prior to the installation of a public water supply for the village.

WELL NO. 1 (South Well), finished in sand and gravel, was completed in April 1954 to a depth of 46.8 ft by the Layne-Western Co., Kirkwood, Mo. The well is located in the Shoal Creek bottomland about 1 mile northeast of town, approximately 1100 ft S and 300 ft W of the NE corner of Section 34, T5N, R4W. The land surface elevation at the well is approximately 475 ft.

A drillers log of Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil and clay	5	5
Sandy clay	12	17
Gravel and clay	11	28
Medium coarse sand and gravel	19	47
Clay and gravel	12	59
Hard brown clay	4	63

A 20-in. diameter hole was drilled to a depth of 63 ft. The well is cased with 16-in. outer pipe from land surface to a depth of 22 ft and an 8-in. pipe from 0.5 ft above the pumphouse floor to a depth of 36.8 ft followed by 10 ft of 8-in. screen (bottom set at 46.8 ft). The annulus around the screen was packed with Meramec gravel.

A production test was conducted on May 4, 1954, by representatives of the driller, the village, the State Water Survey, and James G. Cooney, Consulting Engineer. Prior to the test the well had been pumped and surged. After 3.7 hr of pumping at a rate of 18.3 gpm, the drawdown was 13.33 ft from a nonpumping water level of 16.21 ft below the top of the casing. Continued pumping at a rate of 25.0 gpm for an additional 2.4 hr resulted in a final drawdown of 18.62 ft.

On January 18-19, 1955, the well was pumped at rates from 34.0 to 20.3 gpm for 24 hr with a drawdown of 17.7 ft from a nonpumping water level of 16.4 ft below the top of the casing. Fifty min after pumping was stopped, the water level had recovered to 18.9 ft.

This well was acidized in February and March 1971 by the Layne-Western Co. Before acidizing the well was breaking suction while pumping at a rate of 23 gpm. After treatment the well reportedly produced 27 gpm with a pumping water level of 37.5 ft.

The pumping equipment presently installed is a Myers submersible pump rated at 25 gpm and powered

by a 1-hp 3450 rpm electric motor.

A mineral analysis of a sample (Lab. No. 144207) collected August 9, 1957, showed the water to have a hardness of 149 mg/l, total dissolved minerals of 211 mg/l, and an iron content of 18 mg/l.

A production test was conducted by E. C. Baker & Sons, Inc., Sigel, on August 22, 1972. After 2 hr of pumping at a rate of 20 gpm, the drawdown was 11.18 ft from a nonpumping water level of 31.47 ft.

WELL NO. 2 (North Well), finished in sand and gravel, was completed in May 1954 to a depth of 36 ft by the Layne-Western Co., Kirkwood, Mo. The well is located 352 ft NW of Well No. 1, approximately 775 ft S and 415 ft W of the NE corner of Section 34, T5N, R4W. The land surface elevation at the well is approximately 472 ft.

A correlated drillers log of Well No. 2 at the site of Test Hole No. 3 furnished by the State Geological Survey follows:

Formation	Thickness (ft)	Depth (ft)
PLEISTOCENE SERIES		
Clay, yellow	10	10
Clay, yellow, sandy	7	17
Sand, gray, gravel, medium	18	35
Clay, gray, gravel, medium	17	52
Clay, gray, hard	1	53

A 20-in. diameter hole was drilled to a depth of 36 ft. The well is cased with 16-in. pipe from land surface to a depth of 18 ft and an 8-in. pipe from 0.5 ft above the pumphouse floor to a depth of 26 ft followed by 10 ft of 8-in. screen. The annulus outside the 8-in. casing and screen was packed with Meramec gravel.

On January 20-21, 1955, the well was pumped at rates from 22.4 to 30.0 gpm for 24 hr with a drawdown of 8.77 ft from a nonpumping water level of 15.53 ft below the top of the casing. One hr after pumping was stopped, the water level had recovered to 17.20 ft.

This well was acidized in March 1971 by the Layne-Western Co. Before acidizing the well was reportedly pumped at a rate of 12.2 gpm with a pumping water level of 29.8 ft. After treatment the well reportedly produced 18 gpm with a pumping water level of 27.5 ft.

A production test was conducted by E. C. Baker & Sons, Inc., Sigel, on August 22, 1972. After 2 hr of pumping at a rate of 20 gpm, the drawdown was 7.51 ft from a nonpumping water level of 25.89 ft.

The pumping equipment presently installed is a Myers submersible pump rated at 25 gpm and powered by a 1-hp 3450 rpm electric motor.

A partial analysis of a sample (Lab. No. 136277) collected November 15, 1954, after pumping for 5 hr at 25 gpm, showed the water to have a hardness of 80 mg/l, total dissolved minerals of 132 mg/l, and an iron content of 12 mg/l.

WELL NO. 3 (Park Well), finished in sand and gravel, was originally constructed as a test well in November 1952 to a depth of 189 ft by the Arnold

Wilson Corp., Highland, and was developed into a final well in January 1955 at a depth of 64 ft. This well has not been used since 1966 because of a high mineral content and plans are being made to abandon this well permanently. The well is located in the southeast corner of the village park at the northwest corner of the intersection of National and Academy Sts., approximately 600 ft S and 75 ft W of the NE corner of Section 4, T4N, R4W. The land surface elevation at the well is approximately 560 ft.

A drillers log of Well No. 3 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	24	24
Sand and gravel	4	28
Shale and gravel	7	35
Sand	5	40
Shale and gravel (water at 50 ft)	10	50
Gravel	12	62
Sandy shale	8	70
Shale, blue	15	85
Yellow mud	15	100
Blue mud	20	120
Blue shale	25	145
Gray shale (slight amount of gas at 170 ft)	25	170
Brown lime	3	173
Black slate	5	178
Dark shale	4	182
Brown shale	7	189

At the time of the original drilling it was plugged back to 73 ft and abandoned. A 49-ft length of 10-in. casing extending 0.5 ft above land surface was left in the well. In May 1953, Layne-Western Co., Kirkwood, Mo., cleaned out the well. The hole below the 10-in. casing from 49 to 73 ft had evidently caved in. They installed 53.6 ft of 6-in. pipe and 9.5 ft of 4-in. screen within the 10-in. casing. The bottom of the screen was 63 ft below land surface. In a production test on May 6, 1953, a drawdown of 30.4 ft from a nonpumping water level of 13.9 ft was recorded after 1.25 hr of pumping at a rate of 50 gpm. As pumping continued the pump broke suction even at a reduced rate of less than 15 gpm.

In January 1955 the Friederich Construction Co. had the well cleaned out and a 6-in. cast iron casing from 0.5 ft above the well house floor to a depth of 64 ft installed. The lower 6 ft of the casing was slotted. A production test was conducted on January 14-15, 1955, by representatives of the Construction Co. and the State Water Survey. After 17 hr of pumping at rates gradually declining from 23.2 to 8.5 gpm, the final drawdown was 33.2 ft from a nonpumping water level of 20.8 ft below land surface. Fifteen min after pumping was stopped, the water level had recovered to 46.4 ft.

A partial analysis of a sample (Lab. No. 136737) collected January 15, 1955, after pumping for 15 hr at 8 to 23 gpm, showed the water to have a hardness of 1090 mg/l, total dissolved minerals of 1576 mg/l, and an iron content of 0.5 mg/l.

WELL NO. 4, finished in sand and gravel, was

completed in September 1967 to a depth of 31 ft by the Layne-Western Co., Kirkwood, Mo. The well is located 350 ft W of Well No. 1 and 20 ft N of an access road, approximately 1100 ft S and 650 ft W of the NE corner of Section 34, T5N, R4W. The land surface elevation at the well is approximately 475 ft.

A 20-in. diameter hole was drilled to a total depth of 34 ft. The well is equipped with a 10-in. Monitor pitless adapter from 10.5 ft above land surface to a depth of 3.5 ft, and is cased with 8-in. steel pipe to a depth of 21 ft followed by a 10-ft length of 8-in. No. 5 (0.105 in.) Layne stainless steel shutter screen (bottom set at 31 ft). The annulus between the casing-screen assembly and bore hole is filled with cement from 0 to 10 ft and with torpedo gravel from 10 to 31 ft.

A production test using one observation well was conducted on September 19, 1967, by representatives of the driller, the village, and the State Water Survey. After 3.3 hr of pumping at a rate of 25 gpm, the drawdown was 4.82 ft from a nonpumping water level of 8.15 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 8.79 ft. On the basis of the production test data, it was estimated that this well would yield 25 gpm (36,000 gpd) on a long-term basis.

The pumping equipment presently installed is a Myers submersible pump rated at 25 gpm and powered by a ½-hp electric motor.

The following mineral analysis (Lab. No. 187130) is for a water sample from the well collected November 17, 1971, after 15 min of pumping at 20 gpm.

WELL NO. 4, LABORATORY NO. 187130									
		mg/l	me/l			mg/l	me/l		
Iron(total)	Fe	23		Silica	SiO ₂	21.6			
Manganese	Mn	1.30		Fluoride	F	0.2			
Ammonium	NH ₄	0.9	0.05	Boron	B	0.1			
Sodium	Na	18.9	0.82	Nitrate	NO ₃	0.4	0.01		
Potassium	K	2.3	0.06	Chloride	Cl	10	0.28		
Calcium	Ca	45.6	2.28	Sulfate	SO ₄	67.1	1.40		
Magnesium	Mg	14.6	1.20	Alkalinity (as CaCO ₃)		136	2.72		
Strontium	Sr	0.12							
				Hardness (as CaCO ₃)		174	3.48		
Barium	Ba	<0.1							
Copper	Cu	0.01		Total dissolved					
Cadmium	Cd	0.00		minerals		270			
Chromium	Cr	0.00							
Lead	Pb	<0.05							
Lithium	Li	0.00		Turbidity		159			
Nickel	Ni	<0.05		Color		0			
Zinc	Zn	0.05		Odor		0			

A drillers log of Well No. 4 follows:

Formation	Thickness (ft)	Depth (ft)
Soft brown clay	6	6
Fine brown sand, clay layers	4	10
Medium brown sand, clear	7	17
Coarse gray sand and gravel	14	31
Gray clay and shale	3	34

WELL NO. 5, finished in sand, was completed in May 1972 to a depth of 35 ft by the Layne-Western Co., Kirkwood, Mo. The well is located 1 mile northeast of the village, approximately 135 ft S and 415 ft W of the NE corner of Section 34, T5N, R4W. The land surface elevation at the well is approximately 470 ft.

A drillers log of Well No. 5 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil	2	2
Sandy brown clay	15	17
Medium sand	17	34
Gray clay	10	44

A 20-in. diameter hole was drilled to a depth of 35 ft. The well is equipped with a 7-in. Monitor pitless adapter (Model No. 5PS67PBWEIM) from 10 ft above land surface to a depth of 3 ft, and cased with 8-in. steel pipe to a depth of 24.7 ft followed by 10 ft of 8-in. No. 5 (0.105 in.) Layne shutter screen. The annulus between the hole and casing-screen assembly is filled with concrete from 0 to 10 ft and with gravel from 10 to 35 ft.

A production test was conducted on May 19, 1972, by representatives of the driller, the village, and the State Water Survey. After 3 hr of pumping at a rate of 30.5 gpm, the drawdown was 5.88 ft from a nonpumping water level of 4.77 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 5.89 ft. On the basis of the production test data, it was estimated that this well would yield 30 gpm (43,200 gpd) on a long-term basis.

The pumping equipment presently installed is a Myers submersible pump rated at 20 gpm and powered by a 1½-hp electric motor.

A partial analysis of a sample (Lab. No. 188594) collected during the initial production test, after pumping for 3 hr at 30.5 gpm, showed the water to have a hardness of 160 mg/l, total dissolved minerals of 274 mg/l, and an iron content of 36 mg/l.